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(71) Applicant: RESEAL INTERNATIONAL LIMITED PARTNERSHIP [US/US]; 950 Third Avenue, New York, NY 10022 (US).

(72) Inventor: DEBUSH, George ; 86 Bedford Avenue, Hamden, CT 06517 (US).

(74) Agents: TOREN, David et al.; Akoo-Toren, 521 Fifth Avenue, 21st floor, New York, NY 10175 (US).

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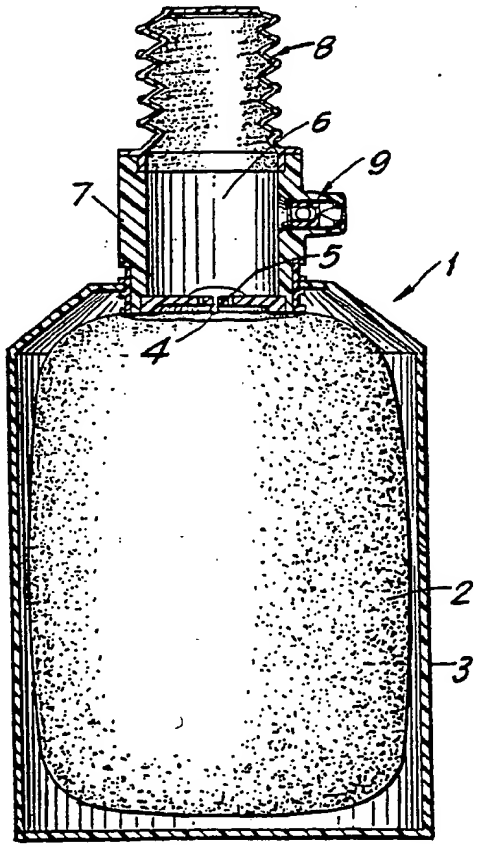
(54) Title: METERED DOSE DISPENSER

(57) Abstract

A metered dose dispenser includes a container (2) for a fluid to be dispensed. The container (2) has an outlet opening (4) for passage of the fluid from the container (2) into a metered dose chamber (6). The metered dose chamber (6) is formed, at least in part of a collapsible tubular wall section (8). A first one-way valve (5) is located between the container (2) and the metered dose chamber (6). A helical spring (16) is formed monolithically with the collapsible tubular wall (8), so that it is returned to the expanded condition after it is collapsed. The container (2), the metered dose chamber (6) and any associated parts are all formed of a recyclable plastics material free of any metal part.



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METERED DOSE DISPENSER

BACKGROUND OF THE INVENTION

The present invention is directed to a metered dose dispenser for repeatedly dispensing selected amounts of a fluid. The dispenser includes a container for the fluid to be dispensed with a metered dose chamber connected to an outlet from the container. Valve means are connected to the metered dose chamber so that fluid can be drawn into the chamber from the container and then a selected amount of the fluid dispensed out of the chamber.

In the past, metered dose dispensers have been used for supplying a predetermined amount of a fluid or liquid from a chamber. One of the problems faced in the past has been to dispense the fluid so that the fluid remaining in the metered dose chamber within the container itself is maintained free of any contamination such as oxygen, other atmospheric gases, bacteria, vapor, dust or dirt from the ambient atmosphere which could enter when the fluid is dispensed.

At the present time, the recycling of containers used for dispensing fluids or liquids is a prime environmental concern. In the past such containers have been formed of a combination of metal and plastic materials making them difficult to recycle. The presence of the metal makes the recycling economically disadvantageous.

One of the metal components for such dispensers is a spring which assures that the metered dose chamber returns to an expanded condition after it is compressed for dispensing the fluid.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a metered dose dispenser capable of repeatedly dispensing a selected amount of a fluid with the entire dispenser formed of recyclable plastics materials.

In accordance with the present invention, the dispenser is made up of a container for the fluid or liquid to be dispensed, a metered dose chamber, a first one-way valve for admitting fluid from the container into the chamber and a second one-way valve for dispensing a metered amount of the fluid while preventing any contaminants from entering the chamber after the completion of the dispensing step. Further, under certain circumstances, a support or housing can be provided for the collapsible container. The container, the one-way valves, the metered dose chamber and the housing if it is used, can all be formed of recyclable plastic material without the inclusion of any metal parts.

A significant feature of the invention is the use of a one-way valve, such as or similar to the Reseal valve

disclosed in the Gerber Patent No. 4,846,810, used as the second one-way valve at the outlet from the metered dose chamber so that the fluid can be dispensed and, at the same time, any contaminants from the ambient atmosphere can be prevented from flowing back into the chamber.

In one embodiment the metered dose chamber can be formed of a rigid section connected to a collapsible wall section. When the collapsible wall section is completely collapsed a metered dose is dispensed from the chamber. The Reseal valve at the metered dose chamber outlet, can be located in the rigid wall section or in the collapsible wall section. Alternately, the chamber can be formed completely by the collapsible wall section.

Another significant feature of the invention is the incorporation of a helical plastics spring in the wall forming the collapsible wall section. The spring is formed monolithically with the collapsible wall section and assures that the collapsible wall section expands from the collapsed condition to its original expanded condition after a dose of the fluid is dispensed. The action of the helical spring assures that the desired amount of fluid is drawn out of the collapsible container after each dispensing step, so that the selected metered dose is available in the chamber.

The helical plastics material spring can be formed of different plastic materials and its size can be varied to achieve the desired operational features of the metered dose chamber.

By monolithically forming the helical plastics materials spring with the wall of the collapsible section of the metered dose chamber, it is assured that the overall device is recyclable.

The helical spring-collapsible wall section can be arranged in different positions relative to the collapsible container or housing. The position can be selected based on ergonomical considerations.

The collapsible section of the metered dose chamber can be of any size compatible with the desired amount of fluid to be dispensed.

Moreover, the helical plastics material spring can be used for a variety of collapsible tubular members for assuring the return of the member to its original position after the spring has been compressed.

A wide variety of plastics material can be used in the dispenser including polyethylene, polyurethane, epoxy resins and the like.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the drawing and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

Fig. 1 is an elevational view, partly in section, of a metered dose dispenser;

Fig. 2 is an enlarged detail view in section of the Reseal valve;

Fig. 3 is an axially extending sectional view of the collapsible wall section of the metered dose chamber;

Fig. 4 is an enlarged partial sectional view taken along line 4-4 in Fig. 3 illustrating the construction of the collapsible wall;

Fig. 5 is a partial view of the dispenser shown in Fig. 1 illustrating various positions of the Reseal valve at the dispenser outlet;

Fig. 6 is a view, similar to Fig. 5, displaying an alternate orientation of the collapsible wall section of the metered dose chamber; and

Fig. 7 is an elevational view of the metered dose chamber in the collapsed condition.

DETAILED DESCRIPTION OF THE INVENTION

In Fig. 1 a metered dose dispenser 1 is shown formed of a collapsible container 2 within a rigid support housing 3. The container 2 has an outlet 4 with a first one-way valve 5 opening on the principle of negative pressure in the outlet for permitting flow from the container into a metered dose chamber 6. The metered dose chamber 6 has a first rigid section 7 connected to the housing 3 and a bellows-like collapsible section 8 secured to and extending outwardly from the rigid section 7. A second one-way valve 9 forms an outlet from the metered dose chamber 6 and extends laterally outwardly from the rigid section 7.

The collapsible container 2 can be in various forms, such as a bag, a bellows-like container, or the combination of the

bag and a piston member movable toward the outlet as the contents of the bag are dispensed.

The second one-way valve 9 is similar to the Reseal valve disclosed in the Gerber Patent No. 4,846,810. The valve 9 is formed of a valve body 10 with a first outlet passage 11 communicating with the material of the metered dose chamber 6 and a second outlet passage 12 extending to the outlet from the second one-way valve 9. The first and second outlet passages 11, 12 are spaced from one another either in the circumferential or axial direction. As shown in Fig. 2, the passages are spaced apart in the axial direction of the valve. The outlet 11a from the first passage and the inlet 12a to the second passage are located through the outside surface 13 of the valve body 10. An expandable membrane sleeve 14 is fitted tightly about the outer surface of the valve body 10 covering both the outlet 11a and the inlet 12a. The membrane sleeve 14 is sealed to the surface of the valve body 10 at its opposite ends, so that flow from the container 2 passes through the first passage 11 and its outlet 11a forcing the membrane sleeve outwardly away from the valve body surface, whereby the fluid from the chamber 6 can flow through the inlet 12a of the second passage and then out through the outlet of the valve.

As the fluid being dispensed flows out through the second passage 12, the membrane 14, no longer expanded outwardly from the valve body 10, rebounds inwardly into contact with the

valve body and prevents any backward flow from the second passage 12 to the first passage 11 and then into the metered dose chamber.

While the valve body 10 is shown as an axially extending part, it is possible to use a flat disk-like part as the valve body. The important consideration is that after fluid has been dispensed, the membrane sleeve 14 is returned into surface contact with the valve body preventing any backflow from the second passage to the first passage.

The second valve 9 is formed completely of plastics material and ensures the sterility of the material being dispensed. This is particularly important for certain pharmaceuticals, such as eye solutions.

As shown in Fig. 1, the collapsible section 8 of the metered dose chamber 6 is a bellows-like member. Such a configuration is particularly desirable where the material forming the bellows member has a memory, so that it returns to the expanded position after it has been compressed for dispensing the fluid. It would be appreciated, however, that other types of collapsible sections can be employed, such as tapered tubular sections or telescoping sections.

As displayed in Fig. 3, the collapsible wall section 8 is formed of a bellows-like tubular wall 15 with a helical spring 16 formed monolithically with this wall. The tubular wall 15 and the helical spring 16 are formed of plastics material. The spring 16 assures that the tubular wall 50 returns to its expanded condition after the metered amount of the fluid has been dispensed. In Fig. 1, the collapsible wall section 8 is shown in the expanded condition. In Fig. 4 it is shown more clearly that the spring 16 is a monolithic part of the wall 15. While the illustrated embodiment displays a bellows-like wall section 8, other types of wall sections incorporating the helical spring 16 can be used. The important feature is that the spring and the rest of the dispenser is formed of recyclable plastics material.

In Fig. 5 the metered dose chamber 6 is shown with the one-way outlet valve 9 in different positions. As in Fig. 1, the valve 9 extends laterally outwardly from the rigid wall section 7 of the chamber. Alternatively, an outlet valve 9a can be positioned in the outer end of the collapsible wall section 8 or it can extend outwardly from an intermediate position, note the valve 9b, in the collapsible wall section.

In Figs. 1 and 5 the collapsible wall section 8 of the metered dose chamber 6 is in axial alignment with the one-way valve 5 between the chamber and the container 2 . Alternatively, depending on the fluid being dispensed and to

facilitate the dispensing direction, the axis of the collapsible wall section 8 can be provided at an angle to the axis of the first one-way valve 5 opening from the container into the metered dose chamber 6.

In operation, as initially supplied, the metered dose dispenser 1 is capped, not shown, with the collapsible wall section 8 in a collapsed condition, note Fig. 7, with the end portion 8a located at the opening from the rigid wall section 7 into the collapsible wall section 8. In this condition, the fluid to be dispensed is located within the collapsible container 2 and also in the rigid wall section 7 of the metered dose chamber 6. When the cover is removed the collapsible wall section 8 expands to the condition shown in Fig. 1. As it expands, it develops a negative pressure within the metered dose chamber causing the first one-way valve 5 to open so that the metered dose chamber 6 is completely filled. The dispenser is now ready to dispense the metered dose.

A metered dose is dispensed by pressing the collapsible wall section inwardly toward the rigid wall section 7 so that the contents within the collapsible wall section are displaced into the rigid wall section and out through the second one-way valve 9. When the force compressing the collapsible wall section is released the spring 16 returns the collapsible wall section to the expanded condition shown in Fig. 1.

As the collapsible wall is returned to the expanded condition, the first one-way valve 5 opens and an amount of the fluid required to fill the expanded collapsible wall section is withdrawn from the container 2 until a positive pressure is developed within the metered dose chamber 6. When the collapsible wall section is again compressed to dispense the fluid, the additional pressure developed within the metered dose chamber closes the first one-way valve 5 and the pressure developed opens the second one-way valve 9 dispensing a metered amount. The metered amount is dispensed only when the collapsible wall section 8 is fully collapsed from the position shown in Fig. 1 to the position shown in Fig. 7. Due to the structure of the second one-way valve 9, after the fluid is dispensed, it is impossible for any contaminants to flow through the second one-way valve 9 back into the metered dose chamber 6.

It should be appreciated, if the collapsible wall section 8 of the metered dose chamber 6 is not fully collapsed to the position shown in Fig. 7, that less than a full metered amount will flow from the dispenser.

By sizing the collapsible wall section 8 on the metered dose chamber 6, a selected dose can be dispensed. It is possible that a stop or a series of stops can be provided for a selected collapse of the collapsible wall section 8, whereby the metered amount can be the full amount determined by the

volume of the collapsible wall section or some fraction of that amount. When completely emptied, the entire dispenser can be recycled.

If it is not important to maintain sterility of the fluid being dispensed, a different one-way valve can be substituted for the Reseal valve 9.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

I CLAIM

1. A metered dose dispenser comprises a container for a fluid to be dispensed, said container has an outlet opening, first means forming a metered dose chamber connected to said outlet opening for receiving fluid from said container and blocking flow from said metered dose chamber back into said container, second means forming a one-way valve connected to said metered flow chamber for dispensing fluid out of the metered flow chamber and preventing backflow through the one-way valve into the metered flow chamber, said container, first means and second means being formed of recyclable plastics material and being free of any metal parts.

2. A metered dose dispenser, as set forth in claim 1, wherein said first means comprises a collapsible tubular wall section and said wall section being collapsible from an expanded condition to a collapsed condition, and means for returning the collapsible wall section from the collapsed condition to the expanded condition.

3. A metered dose dispenser, as set forth in claim 2, wherein said collapsible wall section is an axially extending tubular wall, and an axially extending helical spring incorporated monilithically into said wall for returning said wall to the expanded condition after it is collapsed.

4. A metered dose dispenser, as set forth in claim 3, wherein said wall section is a bellows-like wall.

5. A metered dose dispenser, as set forth in claim 4, wherein said metered dose chamber includes a rigid wall section extending between said collapsible wall section and said container.

6. A metered dose dispenser, as set forth in claim 5, wherein said one-way valve forming said second means is secured to and extends outwardly from said rigid wall section.

7. A metered dose dispenser, as set forth in claim 3, wherein said one-way valve forming said second means is secured to and extends outwardly from said collapsible wall section.

8. A metered dose dispenser, as set forth in claim 1, wherein said container is collapsible as the fluid is dispensed and a rigid housing encloses said container.

9. A metered dose dispenser, as set forth in claim 5, wherein said rigid wall section has an axis, and said collapsible wall section has an axis extending angularly from the axis of said rigid wall section.

10. A device for dispensing uniform amounts of a fluid comprising means forming a metered dose chamber, said chamber has an inlet for introducing fluid into the chamber and an outlet for dispensing fluid out of the chamber, said means include a tubular wall displaceable between a collapsed condition and an expanded condition, said tubular wall includes a helically extending plastic spring formed monolithically with said wall, whereby when a force collapsing the tubular wall is released, said spring returns the tubular wall to the expanded condition.

11. A device, as set forth in claim 10, wherein said tubular wall and said helical spring are formed of a recyclable plastics material.

12. A device, as set forth in claim 11, wherein a first one-way valve is located at the inlet into said chamber so that fluid can be admitted into said chamber but cannot flow back through the inlet valve, and a second one-way valve located in the outlet from said chamber for dispensing fluid from the chamber as the tubular wall is collapsed and for preventing backflow into said chamber when the tubular wall is returned to the expanded condition.

13. A collapsible wall member comprising an axially extending tubular member, an axially extending helical spring formed as an integral part of said tubular member, said

tubular member collapsible from an expanded condition to a collapsed condition and said spring returns said tubular member to the expanded condition when a force collapsing said tubular member is released, and said tubular member and spring formed of recyclable plastics material.

AMENDED CLAIMS
[received by the International Bureau on 25 January 1994 (25.01.94); original claims 1-13 replaced by amended claims 1-20 (7 pages)]

1. A metered dose dispenser comprises a container for a fluid to be dispensed, said container having an outlet opening, first means forming a metered dose chamber connected to said outlet opening for receiving fluid from said container and including a first one-way valve in said outlet opening for blocking flow from said metered dose chamber back into said container, second means forming a second one-way valve connected to said metered dose chamber for dispensing fluid out of the metered dose chamber and preventing backflow through the second one-way valve into the metered dose chamber, said second one-way valve comprising a valve body having serially arranged spaced flow passages therethrough between an inlet into one of said flow passages and an outlet out of another one of said flow passages and third means for affording a positive closure of flow through said flow passages whereby when a sufficient dispensing force is applied to the fluid in said metered dose chamber said third means is displaced allowing fluid flow only through said flow passages from said inlet to one of said flow passages and said outlet from another one of said flow passages and when the dispensing force is discontinued said third means returns to the positive closure of said flow passages.

2. A metered dose dispenser, as set forth in claim 1, wherein said first means comprises a collapsible tubular wall section and said wall section being collapsible from an expanded condition to a collapsed condition, and fourth means for returning the collapsible wall section from the collapsed condition to the expanded condition.

3. A metered dose dispenser, as set forth in claim 2, wherein said collapsible wall section is an axially extending tubular wall formed of a plastics material, and said fourth means comprises an axially extending helical spring incorporated monilithically into said tubular wall and formed of the same plastics material as said tubular wall for returning said tubular wall to the expanded condition after it is collapsed.

4. A metered dose dispenser, as set forth in claim 3, wherein said wall section is a bellows-like wall.

5. A metered dose dispenser, as set forth in claim 4, wherein said metered dose chamber includes a rigid wall section extending between said collapsible wall section and said container.

6. A metered dose dispenser, as set forth in claim 5, wherein said second one-way valve is secured to and extends outwardly from said rigid wall section.

7. A metered dose dispenser, as set forth in claim 3, wherein said second one-way valve is secured to and extends outwardly from said collapsible wall section.

8. A metered dose dispenser, as set forth in claim 1, wherein said container is collapsible as the fluid is dispensed and a rigid housing encloses said container.

9. A metered dose dispenser, as set forth in claim 5, wherein said rigid wall section has an axis, and said collapsible wall section has an axis extending angularly from the axis of said rigid wall section.

10. A device for dispensing uniform amounts of a fluid comprising means for forming a metered dose chamber, said chamber having an inlet for introducing fluid into the chamber and an outlet for dispensing fluid out of the chamber, said means including a tubular wall formed of a plastics material displaceable between a collapsed condition and an expanded condition, said tubular wall having a first thickness and including a helically extending spring formed monolithically with and of the same plastics material as said wall with said spring having a second thickness greater than said first thickness, whereby when a force collapsing the tubular wall is released said spring returns the tubular wall to the expanded condition.

11. A device, as set forth in claim 10, wherein said tubular wall and said helical spring are formed of a recyclable plastics material.

12. A device, as set forth in claim 11, wherein a first one-way valve is located at the inlet into said chamber so that fluid can be admitted into said chamber but cannot flow back through the inlet valve, and a second one-way valve located in the outlet from said chamber for dispensing fluid from the chamber as the tubular wall is placed into the collapsed condition and for preventing backflow into said chamber when the tubular wall is returned to the expanded condition.

13. A collapsible wall member comprising an axially extending tubular member, an axially extending helical spring formed monolithically with said tubular member, said tubular member and spring are collapsible from an expanded condition to a collapsed condition and said spring returns said tubular member to the expanded condition when a force collapsing said tubular member is released, and said tubular member and spring formed of recyclable plastics material.

14. A collapsible wall member, as set forth in claim 13, wherein said tubular member is a helically shaped bellows member comprising a plurality of bellows sections each having a wall thickness and a radially outer helically shaped apex

incorporating said spring with said apex having a larger thickness dimension than said wall thickness.

15. A metered dose dispenser, as set forth in claim 1, wherein said container first means and second means being formed each of a recyclable plastics material and being free of any metal parts, and said container first means and second means being formed of the same recyclable plastics material.

16. A metered dose dispenser comprises a collapsible container for a fluid to be dispensed, said container collapses as the fluid is dispensed, said container having an outlet opening, first means forming a metered dose chamber connected to said outlet opening for receiving fluid from said container and including a first one-way valve in said outlet opening for providing flow from said container into said metered dose chamber and blocking flow from said metered dose chamber back into said container, said first means including an axially extending tubular wall formed of a plastics material and being displaceable between an expanded condition and a collapsed condition, said tubular wall including a helically extending spring formed monolithically with and of the same plastics material as said wall, whereby when a force displacing said chamber into the collapsed condition is released said spring returns the tubular wall to the expanded condition, second means forming a second one-way valve connected to said metered dose chamber for dispensing fluid

out of the metered dose chamber and preventing backflow through the one-way valve into the metered dose chamber, said second one-way valve comprising a valve body having a serially arranged first flow passage and second flow passage disposed in spaced relation with said first flow passage extending from an inlet to said valve body and said second flow passage extending to an outlet from said valve body and third means for affording a positive closure of flow through said flow passages whereby when a sufficient dispensing force is applied to the fluid in said metered dose chamber said third means is displaced from the positive closure allowing fluid flow only through said first and second flow passages from said inlet to said outlet of said valve body and when the dispensing force is discontinued said third means returns to the positive closure.

17. A metered dose dispenser, as set forth in claim 16, wherein said tubular wall comprises a bellows-like tubular wall comprising a plurality of bellows sections having a wall thickness with each said bellows section having a radially outer helically-shaped apex incorporating said spring with said apex having a larger thickness than said wall thickness.

18. A metered dose dispenser, as set forth in claim 17, wherein said tubular wall is formed of a recyclable plastics material and said helical spring is formed of a recyclable

plastics material and said tubular wall and helical spring are formed of the same plastics material.

19. A metered dose dispenser, as set forth in claim 16, wherein said valve body extends axially from said inlet to said outlet thereof, said valve body has an outside surface, said first flow passage extends from said inlet through said outside surface of said valve body and said second flow passage extends from said outside surface to said valve body outlet, and said third means comprises an elastomeric sheath tightly fitted on and enclosing said outside surface of said valve body and means for sealing said sheath to said valve body at a first location between the inlet to said valve body the opening of said first passage through said outside surface of said valve body and at a second location located between the opening of said second passage through said outside surface and said outlet of said valve body.

20. A metered does dispenser, as set forth in claim 19, wherein said bellows-like tubular wall compresses uniformly when the dispensing force is applied to said metered dose chamber.

STATEMENT UNDER ARTICLE 19

Claim 1, as originally filed, has been amended to set forth the arrangement of the "Reseal valve 9" more specifically. In claim 1 the "Reseal valve" 9 has been designated as the "second one-way valve". The second one-way valve includes a valve body with spaced flow passages in the valve body and by a third means for affording a positive closure of the flow passages. The third means is the expandable membrane sleeve 14 fitted tightly about the outer surface of the valve body 10 so that it covers the outlet 12a from the first passage and the inlet 11a to the second passage. The third means or membrane sleeve 14 is sealed to the surface of the valve body 10 at its opposite ends so that flow through the outlet 12a can only flow out through the inlet 11a and then through the second outlet passage 11.

Claim 10 has been rewritten to point out more specifically the structure forming the metered dose chamber with the helically extending spring formed monolithically with the wall of the chamber and pointing out the differences in the thickness of the wall of the chamber and of the spring as illustrated in Figs. 3 and 4.

Claim 13 has been rewritten to point out that the helical spring is formed monolithically with the wall of the chamber and that there are differences in the thickness of the wall of the chamber and of the spring as illustrated in Figs. 3 and 4.

Further, claim 13 sets forth that the helical spring is formed monolithically with the tubular member and that the tubular member and spring collapse uniformly.

Claims 14 to 20 have been added. Claim 14 is dependent from claim 13 and points out the relative differences in the wall thickness of the bellows section and of the spring located at the apex of the bellows sections.

Claim 15 has been added, depending on claim 1, to point out that the container, the first means and the second means of claim 1 are formed of a recyclable plastics material and are free of any metal parts and are all formed of the same recyclable plastics material.

Claims 16-20 have been added directed to the subject matter as set forth in claim 1 and also to the helically extending spring as set forth in claim 13. Claim 17 sets

forth the tubular wall as a bellows-like tubular wall formed of a plurality of bellows sections.

Claim 18 points out that the tubular wall is formed of a recyclable plastics material as is the helical spring and that the tubular wall and helical springs are formed of the same plastics material. Claim 19 sets forth the structure of the valve body in greater detail.

Claim 20 points out that the bellows-like tubular wall compresses uniformly, that is, all of the bellows sections collapse at the same time, rather than an arrangement where first one bellows section collapses and after it is fully collapsed the next section collapses.

It is respectfully requested that the claims 1 - 20 as enclosed herewith be entered in place of claims 1 - 13 as originally filed.

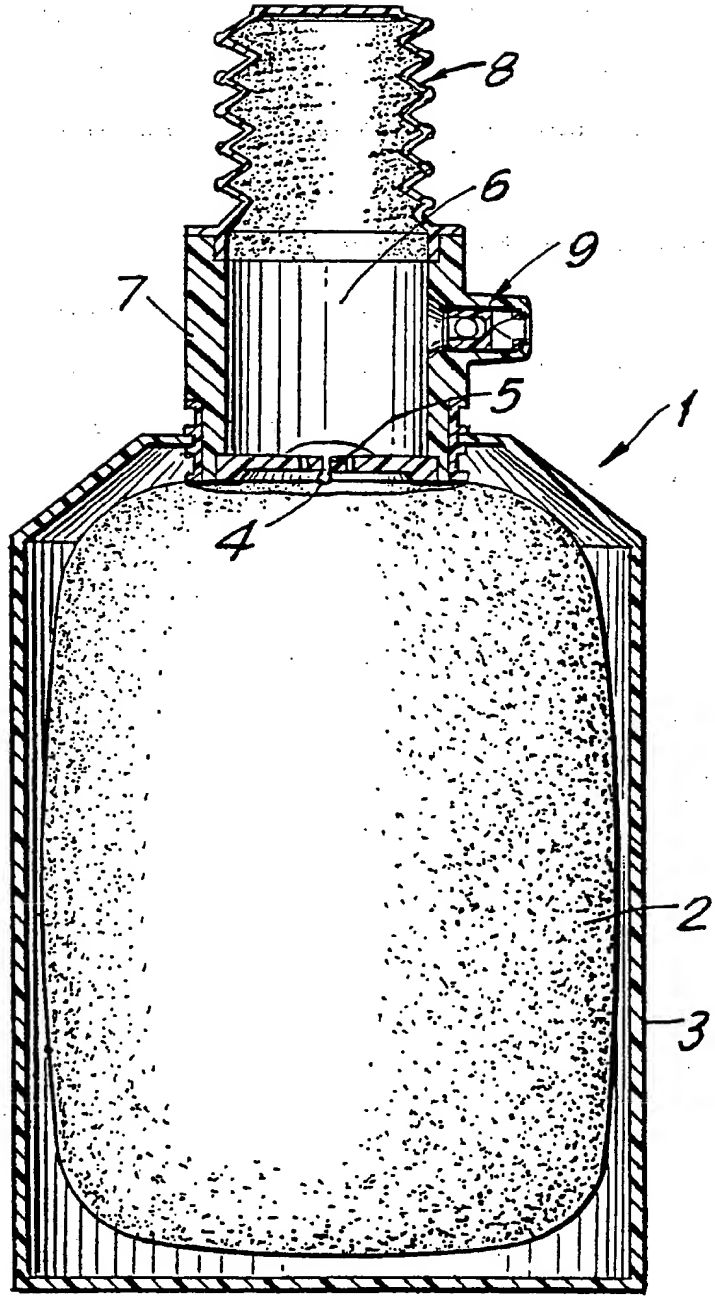

FIG. 1

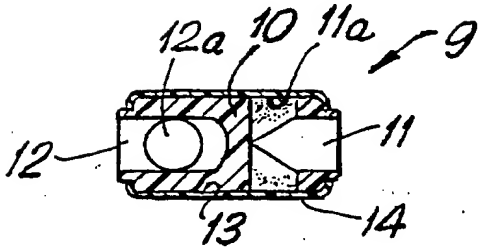

FIG. 2

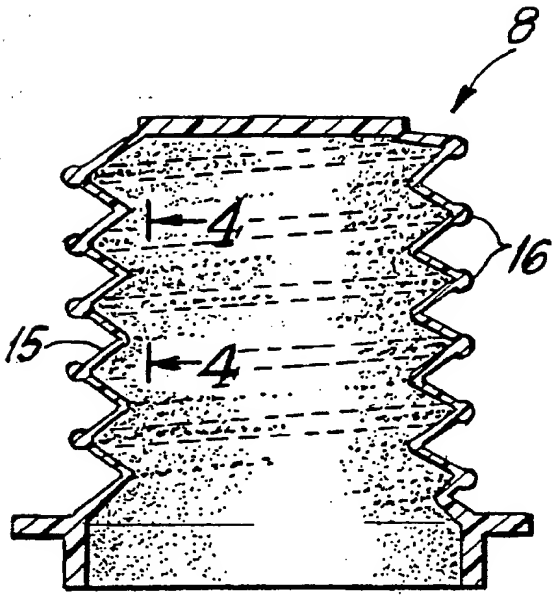

FIG. 3

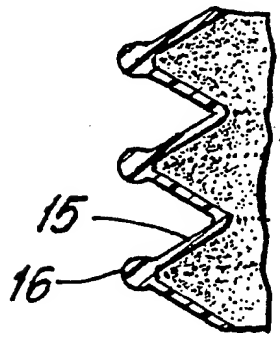

FIG. 4

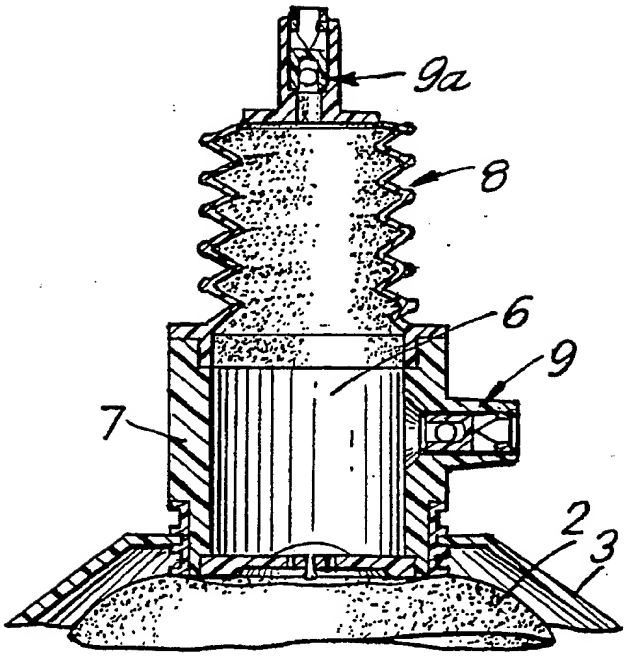

FIG.5

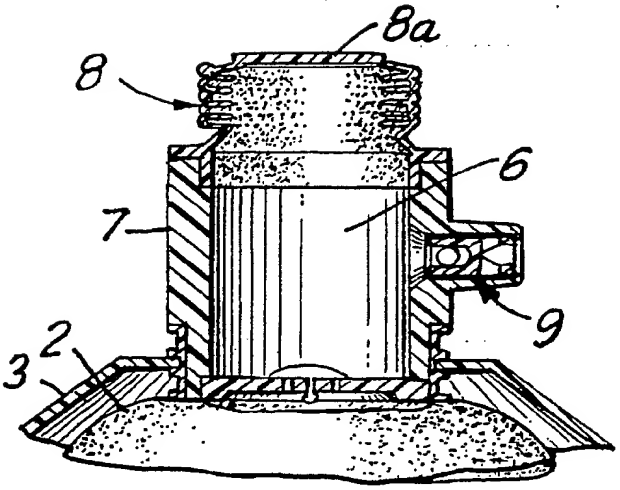

FIG.7

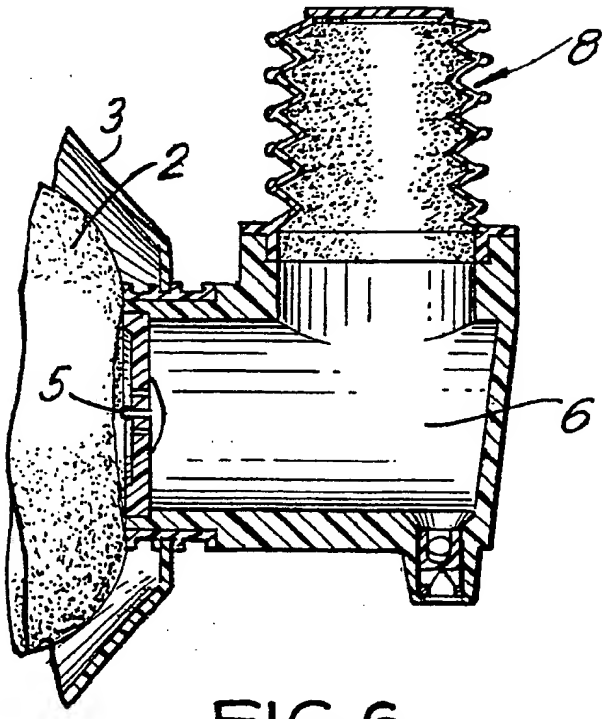

FIG.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/08964

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B67D 5/40
US CL :092/42, 46; 222/207, 383
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 092/34, 42, 46
222/95, 207, 209, 321, 383

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US, A, 4,863,070 (Andris) 5 September 1989 column 4, line 17 to column 8 line 58	1-2 ---- 3-9
Y	US, A, 3,124,275 (Lake) 10 March 1964 column 2, lines 13-61	3-7 and 9-12
Y	US, A, 4,102,476 (Loeffler) 25 July 1978 Fig 1, Fig 4, column 5, lines 40-51	8
Y	CA, A, 703,528 (Eskridge) 9 February 1965 page 6, lines 22-25	13

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 November 1993	22 NOV 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer KENNETH BOMBERG Telephone No. (703) 308-1113

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